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THE IMPORTANCE OF DEW IN WATERSHED-MANAGEMENT RESEARCH

Many studies, using various methods, have been made of dew deposition to determine its importance as a source of moisture. For example, Duvdevani (1947) used an optical method in which dew collected on a wooden block was compared with a set of standardized photographs of dew. Potvin (1949) exposed diamond-shaped glass plates at 45° to ground level, so that condensed dew ran into a graduate. Lloyd (1961) studied amount and duration of dew by using polystyrene blocks mounted on a balance linked to a 7-day continuous recorder. Craddock (1951) devised a sub-groundlevel balance and recorder to give continuous records of dewfall on a soil mass or a plant surface at groundlevel; and the Craddock recorder was later — in 1954 — improved upon by Jennings and Monteith.

The formation of dew is generally limited to clear nocturnal periods when exposed surfaces are cooling and have temperatures below the dewpoint of the surrounding air. Visible dew comes from three separate sources: (1) true dewfall, or condensation of water vapor from the atmosphere; (2) distillation, or condensation of water vapor from transpiring leaves or warmer, sufficiently moist soils; and (3) guttation, or exudation of liquid from certain parts of leaves (Slatyer and McIlroy 1961). Only the first source, dewfall, represents a direct addition of moisture to the plant-soil system.

Either artificial or natural collection surfaces can be used to measure dewfall and distillation. However, some scientists feel that artificial objects do not indicate the correct amount of dew received. Angus (1959) and Slatyer and McIlroy (1961) advocated weighing an isolated representative portion of the natural surface as the most reliable method of determining dew deposition.

Is Dew Important?

The Fernow Experimental Forest, near Parsons, West Virginia, where watershed-management research is being carried on, has been observed to be an area where dew deposition is heavy. The question arose: Is dew deposition important enough as a source of moisture to be considered in our watershed-management studies?

So in the summer of 1962 an exploratory study of dew deposition was made in an open area on flat bottomland adjacent to the Fernow Experimental Forest headquarters. The purposes of the study were: (1) to determine the general magnitude of dew deposition, and (2) to test the feasibility of using a modified recording rain gage for measuring dew.

To use a natural surface for measuring dew deposition, the rain gage was modified to accommodate a section of live turf (fig. 1). The turf was held on a plate, 17.89 inches in diameter, supported on a pedestal in the bucket of the gage. The turf plate provided a deposition area five times as large as the rain-gage orifice, causing the scale on the

Figure 1.—Recording rain gage modified to measure dewfall. The live turf was used to provide a natural surface for collecting dew.

Table 1. — *Dew deposition in an open area adjacent to Fernow Experimental Forest headquarters*

Period (1962)	Accumulation for period	Occurrence of dew deposition	Average measurable deposit	Maximum dew deposition during period
	Inches	*No. days*	*Inches*	*Inches*
May	0.030	19	0.0016	0.004
June	.051	19	.0027	.005
July	.044	19	.0023	.005
August	.055	23	.0024	.005
September	.032	13	.0025	.005
October	.030	10[1]	.0030	.007
November[2]	.017	8	.0021	.004
May-November	.259	111	.0024	.007

[1]Totals for October do not include 10 days of missing record caused by instrumentation difficulties.
[2]November values include frost deposition.

recorder chart to be magnified by five. The chart drum was equipped with a 96-hour gear, and dew deposition could easily be read from the chart to the nearest 0.001 inch.

Increases in moisture caused by dew deposition could be differentiated from those caused by rainfall by the nature of the pen trace. Dew deposition caused slow, gradual rises: rainfall caused more rapid and generally larger rises. General weather observations also aided in chart interpretation.

Measurement Values

Dew measurement values for May through November 1962 are shown in table 1. Total monthly dew deposition ranged from 0.017 to 0.055 inch, and the total for the 7-month period was 0.259 inch. Maximum daily accumulation during the 7-month period was 0.007 inch. Dew or frost was recorded on 111 of the 200 days of record.

A visual observation of the occurrence of dew showed that there were usually 3 to 6 days in each month when dew formed but was not recorded by the gage. Assuming that deposition on each of these days amounted to 0.0005 inch — half the amount that would show on the recorder — the maximum unrecorded amount in any month would be 0.003 inch. This was considered negligible.

In most instances, deposition began registering on the dew chart by 9 p.m. Maximum accumulation was usually reached between 6 and 7 a.m., and the dew usually evaporated by 9 a.m. Most of the November deposition was observed to be frost. Frost formation followed the same pattern as dew, with the possible exception that it formed later in the evening. Water content of the frost formations did not differ greatly from that of the dew deposits.

The average daily dew deposit was relatively uniform for the 7 months of record, ranging from 0.0016 to 0.0030 inch. During July, August, and September the average deposition for the nights when dew occurred was 0.0023, 0.0024, and 0.0025 inch, respectively. The total deposition for these 3 months was 0.131 inch, or 1.2 percent of the 10.76 inches of precipitation that occurred during the period.

A dew study reported by Lloyd (1961) revealed that the nightly averages for the same 3 months in 1958 in an open area in northern Idaho were 0.0069, 0.0033 and 0.0036 inch. The total deposition for these 3 months in northern Idaho was 0.39 inch, or 13 percent of the 2.96 inches of rainfall that occurred during the period.

Since the height of the collection surface on the Fernow dew gage was 3 feet above ground level, the question arose as to how much variation occurred between the dew deposition at ground level and on the gage. Lloyd (1961) showed that dew deposition at 5 feet height was about twice that at 1 foot. Deposition at 2 feet was halfway between that at 1 and 5 feet, and maximum deposition occurred at 10 feet. Baumgartner (1956) found dew deposition in the open at 1 meter to be more than twice that at ½ meter; maximum depostiion was at 1½ meters and was more than 3 times the ½ meter amount. Both of these studies showed a tendency for dew deposition to be greater at several feet above ground level — indicating that the Fernow dew gage may have shown higher totals than actually occurred at ground level.

In our study, dew deposition was measured only in the open. Results shed little light on what might occur under, within, or at the top of the forest canopy. Geiger (1959), writing on dew in the forest, states that "Most of the dew, as I have several times been able to observe, is deposited on the upper surface of the crown, decreasing continuously and decidedly downward into the inside of the stand. Above the crown, the deposition of dew was so great at times that it required several hours of sunshine to complete its evaporation." Lloyd (1961) found no dew deposition under a closed forest canopy, and observed heavy dew on top of a closed canopy of alder.

The extent to which night depositions of dew retard evapotranspiration on the following day is still uncertain. And the possibility of dew entering the plant system is another point of controversy. These two points are not explored here, although they bear on the importance of dew in the hydrologic cycle.

Conclusion

The total amount of dew measured in the open at the Fernow Experimental Forest headquarters was not large. The total for August, the month of maximum deposition, was 0.055 inch — only 1 percent of the mean August precipitation (5.7 inches).

In any month, the error in precipitation measurements on most small experimental watersheds very likely exceeds 0.055 inch. Thus the amount of dew at this location is probably not large enough to warrant its being measured in watershed-management studies.

The modified rain gage appears to be capable of measuring deposition for comparison with precipitation, streamflow, soil moisture or other watershed measurements, but perhaps is not accurate enough for basic studies of dewfall.

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— JAMES W. HORNBECK
Research Forester
Northeastern Forest Experiment Station
Forest Service, U. S. Dept. Agriculture
Parsons, W. Va.